DESERT RESEARCH INSTITUTE
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AN ANALYSIS OF THE POTENTIAL IMPACTS OF WATER WITHDRAWALS BY PHOENIX INN, INC. ON DEATH VALLEY NATIONAL MONUMENT

for
Superintendent
U.S. National Park Service
Death Valley National Monument
Death Valley, CA 92328

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WATER RESOURCES CENTER

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ABSTRACT

This report addresses evidence in support of the U.S. National Park Service protest of water rights applications by Phoenix Inn, Inc. of Beatty, Nevada. Phoenix Inn, Inc. applied for two permits to appropriate public waters on November 16, 1988. Application number 54223 appropriates 0.5 cfs from an unnamed spring and application number 54224 appropriates 1.0 cfs from an underground source. The water is to be used for recreational purposes for a proposed development in Beatty, Nevada. Beatty is approximately 15 miles upgradient from Death Valley National Monument and lies within the Oasis Valley hydrographic sub–basin. The regional ground–water flow is from the northwest toward Death Valley. Ground water flows from Oasis Valley to Amargosa Desert hydrographic sub–basin and discharges into Death Valley sub–basin. The potential impacts from the proposed diversions of surface and ground waters in Oasis Valley on the water resources of Death Valley National Monument include declining ground–water levels and decreasing spring discharges. These effects are direct or indirect responses to water–level changes associated with aquifer development, and are related to disturbances of the natural equilibrium between aquifer recharge and discharge. Diversion of the spring flow in Beatty could reduce the amount of water available for ground–water recharge. Development of the ground–water right will produce local water–level declines and add to the total amount of water already being withdrawn from Oasis Valley. A well designed ground–water monitoring system is the best way to mitigate against the potential adverse effects of development of the proposed ground and surface water diversions. The monitoring system should consist of water–level measurements in the pumping well, a monitoring well and spring discharge with an agreed upon ground–water level decline or spring–flow decline trigger value. The ground–water monitoring system would protect both the National Park Service and Phoenix Inn, Inc.

INTRODUCTION

Purpose and Objectives

The purpose of this report is to provide evidence in support of the U.S. National Park Service (NPS) in the hearing of the Nevada State Engineer's Office concerning two water–right applications submitted by Phoenix Inn, Inc. in Beatty, Nevada. The NPS protested these applications to divert ground and surface water for landscape and recreational use. The proposed diversions, if approved by the Nevada State Engineer and developed, may impact the water resources, water rights, and water related resources of Death Valley National Monument. Data from the available literature are used to show that a ground–water monitoring system is needed to safeguard the water resources at Death Valley National Monument from development by the Phoenix Inn, Inc.

Water–right Applications of Phoenix Inn, Inc.

The Phoenix Inn, Inc. applied for two permits to appropriate public waters on November 16, 1988. Application number 54223 appropriates 0.5 cfs from an unnamed spring, and application number 54224 appropriates 1.0 cfs from an underground source. The water will be used for recreational purposes for a proposed development in Beatty, Nevada.

Location of Study Area

The study area is located in southwestern Nevada, approximately 120 miles west–northwest of Las Vegas and approximately 15 miles from the Death Valley National Monument boundary (Figure 1). Beatty, Nevada is within the Oasis Valley hydrographic sub–basin (Figure 2). Oasis Valley is bounded by mountains composed primarily of volcanic rocks, while the valley fill is composed of sedimentary detritus from the surrounding mountains (the valley fill may be as much as 2,000–feet thick). The highest peak adjoining the valley is Pyramid Peak (6,703 feet above mean sea level), while the valley floor is at an elevation of approximately 2,000 feet. Ground–water flows from Oasis Valley to Amargosa Desert hydrographic sub–basin and discharges into Death Valley sub–basin. The Death Valley Basin hydrographic region includes in addition to Oasis Valley, Amargosa Desert and DeathValley sub–basins the following sub–basins: Crater Flat, Fortymile Canyon, Rock Valley, Mercury Valley (Rush et al, 1971; Kilroy, 1991: Waddell et al, 1984). Other surrounding hydrographic sub–basins of interest to the study area are Gold Flat, Sarcobatus Flat and Kawich Valley.

Previous Work

Past hydrogeologic studies have been conducted to evaluate the water–resources potential of the area (Malmberg and Eakin, 1962; Walker and Eakin, 1963; Malmberg and Eakin, 1964)

Figure 1. Location of study area in southern Nevada and eastern California.

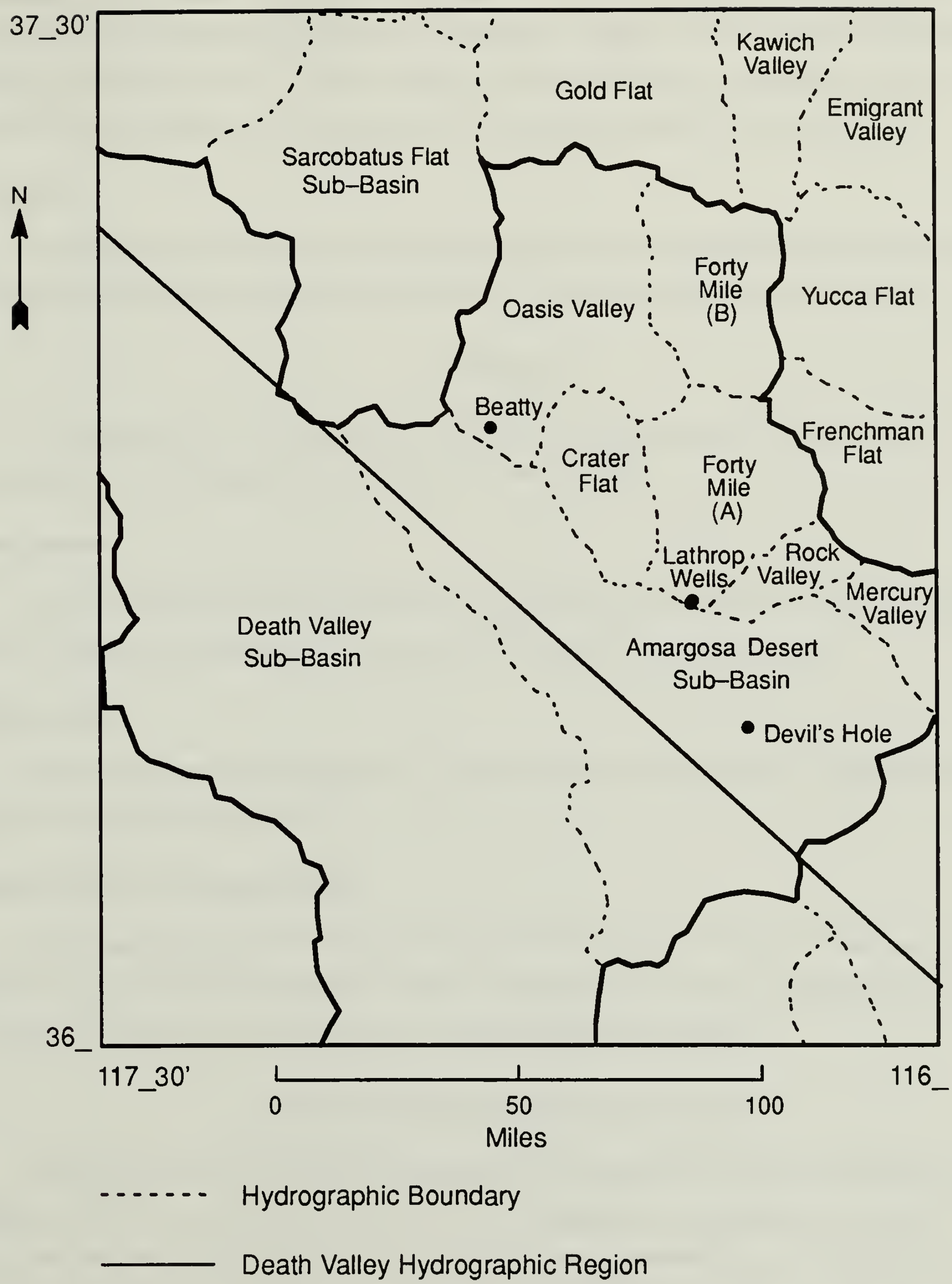


Figure 2. Map of hydrographic basin boundaries in southern Nevada and eastern California.

to evaluate the impacts of ground–water pumping (Dudley and Larson, 1976), and to evaluate regional ground–water flow (Blankennagal and Weir, 1973; Winograd and Thordarson, 1975; Claassen, 1975; Waddell et al, 1984; Bedinger et al., 1989; Dettinger, 1989; Burbe and Prudic, 1991). A specific hydrologic study was conducted by Akers (1974) to evaluate the hydrologic relation of ground water in the Amargosa Desert to spring discharge in Death Valley. Ground–water conditions in the Amargosa Desert were evaluated by Kilroy (1991).

Methods

The methods used to prepare this report were a review of the available literature and the knowledge of the authors based on more than 15 years of work in southern Nevada.

CLIMATE

The climate of the study area is arid. Within the study area, the National Weather Service has collected meteorologic data at Beatty and Lathrop Wells.

Precipitation

The average annual precipitation over a 10–year period from 1952 to 1961 yielded 4.51 and 3.76 inches of precipitation for Beatty and Lathrop Wells, respectively.

Temperature

The average annual temperature in Beatty for the same time period equaled 60°F with extremes ranging from 115 to 1°F.

Evaporation/Evapotranspiration

The evaporation rate in the area is high, particularly in the summer, because of the low humidity and the high temperatures. Studies conducted in the area by Nichols (1987) suggest that nearly 75 inches of water are lost to evapotranspiration annually.

PERMITTED DIVERSIONS OF WATER

Currently in the Oasis Valley hydrographic area, there are 23 surface water appropriations totaling 1879.51 acre–feet per year, and 13 underground appropriations totaling 2753.68 acre–feet per year (Table 1). Four of the underground appropriations are supplemental water rights for municipal use. Supplemental water rights are given to wells that are used as back–up water supplies in the event that the primary supply wells are out of service. Therefore, the total permitted, certificated, and ready for use rights for Oasis Valley range from 3320.95 to 3921.78 acre–feet per year (depending on which supplemental well is in use).

TABLE 1. APPROPRIATED WATER RIGHTS FOR OASIS VALLEY (Nevada State Engineer, 1991, unpublished data).

App. No.	Type	Div. Rate (cfs)	Annual (Acre–Ft/Year)
269	SPG	5.000	400.00
270	SPG	2.000	400.00
1197	SPG	0.080	29.19
1746	SPG	0.030	21.72
1751	SPG	0.410	222.63
6725	UG	0.001	1.11
9606	UG	0.002	1.11
9908	SPG	0.024	17.70
10563	SPG	0.037	51.55
10664	SPG	0.003	2.18
10668	SPG	0.003	2.18
11850	SPG	0.750	299.98
12075	UG	0.070	20.40
12488	SPG	1.000	87.60
12489	UG	0.220	54.20
17327	SPG	0.055	39.80
17328	SPG	0.055	39.80
20890	UG	0.170	123.01_s
21514	SPG	2.170 changed to # 24460	
22838	UG	0.290	209.88_s
22839	UG	0.523	378.52_s
24460	SPG	0.530	212.50
25628	SPG	0.005	3.68
28808	SPG	0.040	12.50
30294	SPG	0.120	34.50
38126	UG	2.000	451.06
42473	UG	2.000	400.00
44236	UG	0.250	30.68
45567	UG	0.690	352.87_r
46692	SPG	0.004	0.00
46693	SPG	0.003	0.00
46694	SPG	0.005	0.00
47342	UG	0.020	7.00
52045	UG	1.000	723.84_s
52437	SPG	0.010	2.00
54200	SPG	0.700	0.00
54223	SPG	0.500	0.00
54224	UG	1.000	0.00

TYPE: SPG = Spring; UG = Pumped Ground–water; s = supplemental; r = ready for action

HYDROGEOLOGY

The geology of the study area is extremely complex, both lithologically and structurally. The oldest geologic units in the area are paleozoic rocks of various lithologies: carbonate (limestone and dolomite) and non–carbonate (shale, quartzite, siltstone, etc.). These units are educationally overlain by tertiary volcanic ash–fall tuff, sedimentary valley–fill, playa, and lakebed deposits, and Quaternary alluvium. This geologic complexity is hydrologically important and must be considered in predicting development effects.

Springs and seeps in the area issue primarily from carbonate–rock aquifers and to a lesser extent from non–carbonate aquifers. Water from the Paleozoic aquifers are generally from regional ground–water flow systems (Mifflin, 1968; Dettinger, 1989). Previous studies suggest that regional ground–water flow systems may be interconnected from Death Valley to the White River flow system, some 300 miles northeast of Death Valley.

Most ground water is pumped from valley fill and alluvial aquifers overlying the bedrock aquifers. The impact from pumping in the sedimentary aquifers on the underlying carbonate aquifers is poorly understood. At Ash Meadows, direct connections between pumping from the alluvial aquifers and water level declines in the carbonate rocks were demonstrated. Ground–water development near Devils Hole lowered water levels by more than a foot in the carbonate aquifers between 1969–72 (Bateman et al, 1974; Dudley and Larson, 1976). The water levels recovered slowly over a period of about 15 years after pumping ceased. A study conducted by Akers (1974) showed that heavy pumping in the Amargosa hydrologic basin may produce decreased spring flow in Death Valley in 10 to 40 years.

SURFACE WATER HYDROLOGY

Only small amounts of surface water are found within the study area. Several small springs exist near Beatty, in the Amargosa Desert and in Death Valley. Discharge from the springs varies from a seep to over 100 GPM, all of which either is collected for consumptive use or flows a short distance before percolating into sedimentary units and/or being evapotranspired. Additionally, several small ponds exist in Amargosa Valley at the locations of borrow pits, where the water table has been intersected. Runoff from intensive precipitation may occur for short periods of time in wash or stream beds in the area.

GROUND–WATER HYDROLOGY

Recharge

Ground–water recharge is primarily derived from precipitation in the mountains and, to a lesser extent, from rapid infiltration of runoff along washes. The average annual recharge from precipitation is shown in Table 2.

TABLE 2. GROUNDWATER RECHARGE NEAR DEATH VALLEY.

Sub–Basin	Estimated Recharge Acre–Ft/Year	Source
Oasis Valley	250	Malmberg & Eakin, 1962
Sarcobatus Flat	1200	Malmberg & Eakin, 1962
Amargosa Desert	3000–19,000	Harrill, 1992
Death Valley	8,000	Harrill et al., 1988

Discharge

Natural ground–water discharge occurs by transpiration from plants, evaporation from soil and free–water surfaces, and as interbasin flow. Evapotranspiration is by far the greatest source of ground–water discharge in the system. However, significant interbasin ground–water flow also exists within the study area (Table 3). Assuming the hydrographic basin is in equilibrium, it would be necessary to add approximately 2150 acre–ft/year of inter–basin inflow to balance the system; however, further studies are necessary to accurately quantify this value.

TABLE 3. GROUNDWATER DISCHARGE NEAR DEATH VALLEY.

Sub–Basin	Estimated Discharge Acre–Ft/Year	Interbasin Flow Acre–Ft/Year	Source
Oasis Valley	2200	200	Malmberg & Eakin, 1962
Sarcobatus Flat	5800	500	Malmberg & Eakin, 1962
Amargosa Desert	23,500	500	Walker & Eakin, 1963
Death Valley	20,000 – 25,000	3,000	Harrill et al., 1988; Miller, 1977

Directions of Ground–water Flow

Water levels in the study area and surrounding areas suggest that regional ground–water flows from the northeast toward Death Valley. However, the ground–water flow direction is constrained by lithologic and structural variations along the flow path, by mountain block recharge area, and by man–made sinks from ground–water pumping. Potentiometric surface maps have been developed for the region near Beatty by Winograd Thordarson (1975), Dudley

and Larson (1976), Waddell et al (1984), Bedinger, et al. (1984); the maps from these studies suggest that the ground water near Beatty flows southwesterly toward the Death Valley National Monument (Figure 3).

Water Budget

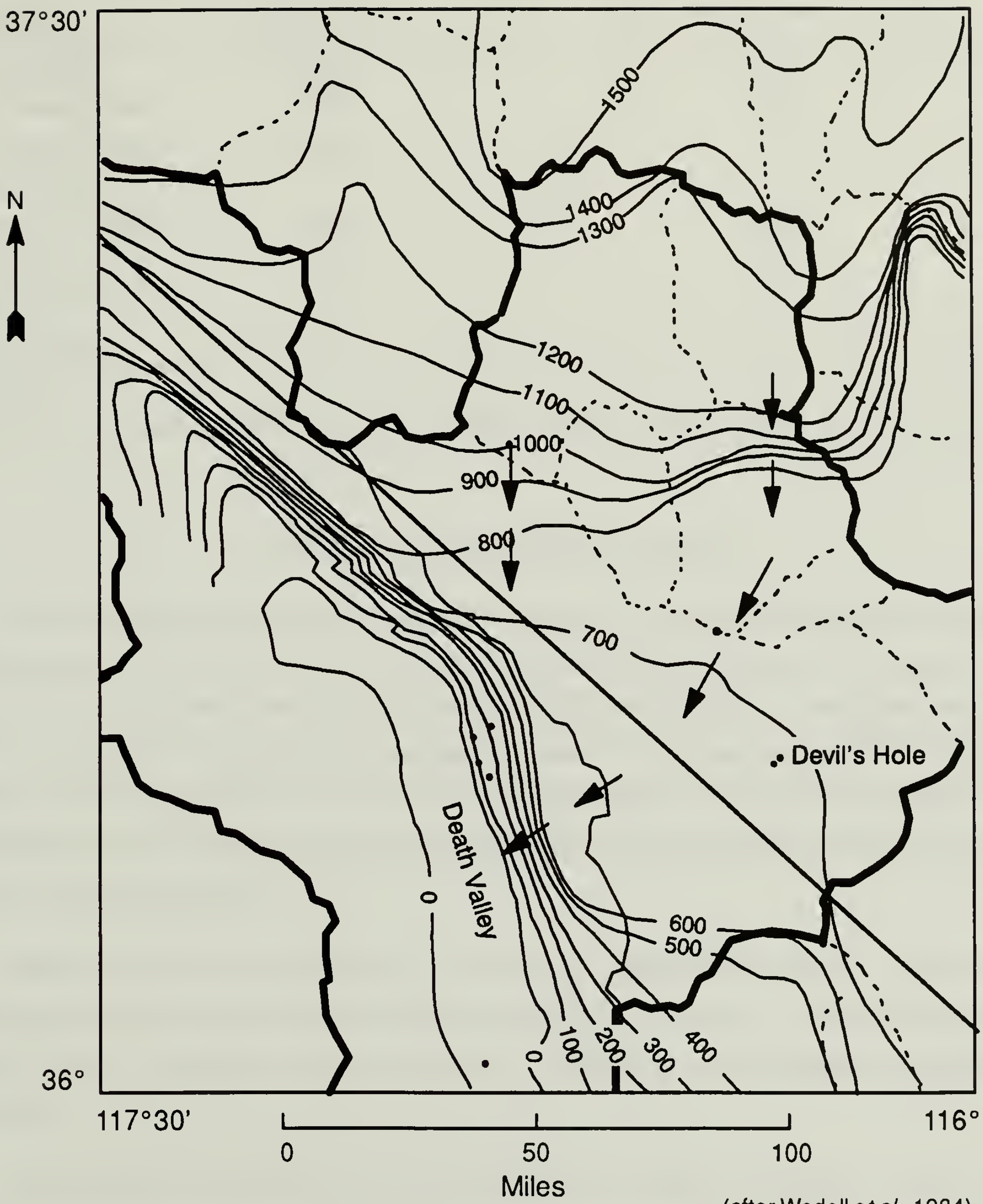
Nevada law limits the amount of ground water that can be appropriated for a hydrographic basin to the ground–water replenishment of the basin, in some cases this may exceed the perennial yield where secondary ground–water recharge may be occurring due to the application of diverted surface water. The perennial yields for each basin have been estimated from water budgets for each basin (Table 4).

POTENTIAL EFFECTS OF THE PROPOSED DIVERSIONS

The potential impacts of the proposed diversions of surface and ground waters in Oasis Valley on the water resources of Death Valley National Monument include declining ground–water levels and decreasing spring discharges. These effects are direct or indirect responses to water–level changes associated with aquifer development, and are related to disturbances of the natural equilibrium between aquifer recharge and discharge. A reduction in the ground–water outflow from Oasis Valley into Amargosa Desert may result from the water diversions. This in turn could effect the water resources in Death Valley sub–basin and of Death Valley National Monument.

Diversion of the spring flow will reduce the amount of water that is potentially available for recharge to the ground–water system. The development of the ground–water right will produce local water–level declines and add to the amount of water already being withdrawn from Oasis Valley.

The best way to mitigate the potential adverse effects of the development of the proposed diversions is to develop and maintain a ground–water monitoring system consisting of water–level measurements in the pumping well and a monitoring well, measurements of spring discharge and an agreed upon ground–water level decline or spring flow decline trigger value. When that trigger level is reached, a reduction in water withdrawals would be required. The ground–water level monitoring program would protect both NPS and Phoenix Inn, Inc. If a potential adverse water–level decline was detected, the ground–water monitoring system would enable one to determine which water diversions were responsible for the observed ground–water level decline.



(after Wadell *et al.*, 1984)

- - - - - - - Hydrographic Boundary

——— Potentiometric Contour (altitude in meters)

Figure 3. Groundwater flow directions in southern Nevada and eastern California.

TABLE 4. PERENNIAL YIELD FOR BASINS NEAR DEATH VALLEY.

Sub–Basin	Perennial Yield Acre–Ft/Year	Appropriated Groundwater Acre–Ft/Year
Oasis Valley	2200	1580
Sarcobatus Flat	3500	1825
Amargosa Desert	24,000	*
Death Valley	*	*
Fortymile Canyon	7000	162
Crater Flat	900	2595
Mercury Valley	*	*
Rock Valley	*	*

*no data

Modified from Malmberg and Eakin, 1962; Walker and Eakin, 1963; Special Nevada Report, 1991

SUMMARY AND CONCLUSIONS

This report provides evidence in support of the U.S. National Park Service in their water rights dispute with Phoenix Inn, Inc. of Beatty, Nevada. The NPS protested the applications by Phoenix Inn, Inc. to divert ground and surface water for landscape and recreational use. Phoenix Inn, Inc. applied for two permits to appropriate waters on November 16, 1988. Application number 54223 appropriates 0.5 cfs from an unnamed spring, and application number 54224 appropriates 1.0 cfs from an underground source. The proposed diversions could impact Death Valley National Monument.

Beatty, Nevada is approximately 15 miles up gradient from Death Valley National Monument and lies within the Oasis Valley hydrographic sub–basin. Groundwater flows from Oasis Valley to Amargosa Desert hydrographic sub–basin and discharges in Death Valley sub–basin.

The climate of the study area is arid. Precipitation at Beatty averages 4.51 inches and the average annual temperature is 60°F with extremes ranging from 1 to 115°F. Evapotranspiration is approximately 75 inches per year.

The perennial yield of Oasis Valley is 2200 acre–feet per year. Currently in the Oasis Valley hydrographic sub–basin, there are 23 surface water appropriations totaling 1879.51 acre–feet per year, and 13 underground appropriations totaling 2753.68 acre–feet per year. However, four of the underground appropriations are supplemental water rights for municipal use. The total

permitted, certified, and ready for use underground rights for Oasis Valley range from 3320.95 to 3921.78 acre–feet per year (depending on which supplemental well is in use).

Ground–water recharge in Oasis Valley is estimated to be 250 acre–feet per year and is primarily derived from precipitation in the mountains and along washes. Natural ground–water discharge occurs by evapotranspiration and interbasin flow. The regional ground–water flow is from the northeast toward Death Valley. However the ground–water flow is constrained by lithologic and structural variations along the flow path, by mountain block recharge, and by man–made sinks associated with ground–water pumping.

The potential impacts from the proposed diversions of surface and ground waters in Oasis Valley on the water resources of Death Valley National Monument include declining ground–water levels and decreasing spring discharges. These effects are direct or indirect responses to water–level changes associated with aquifer development, and are related to disturbances of the natural equilibrium between aquifer recharge and discharge. Diversion of the spring flow in Beatty will potentially reduce the amount of water available for ground–water recharge. Development of the ground–water right will produce local water–level declines and add to the total amount of water already being withdrawn from Oasis Valley.

A well designed ground–water monitoring program is the best way to mitigate the potential adverse effects of development of the proposed ground and surface water diversions. The monitoring program should consist of water level measurements in the pumping well and a monitoring well, measurements of spring discharge, and an agreed upon ground–water level decline or spring flow decline trigger value. The ground–water monitoring program would protect both the National Park Service and Phoenix Inn, Inc.

REFERENCES CITED

Akers, J.P., 1974, "The relation of groundwater flow in the Amargosa Desert, California–Nevada, to spring discharge in Death Valley, California." U.S. Geological Survey Administrative Report, Menlo Park, California, pp 9.

Bateman, R.L., Mindling, A.L., and Naff, R.L., 1974, "Development and management of ground water in relation to preservation of desert pupfish in Ash Meadows, southern Nevada." University of Nevada, Desert Research Institute Publication 17, pp 39.

Bedinger, M.S., Harrill, J.R., Langer, W.H., Thomas, J.M. and Mulvihill, D.A., 1984, "Maps showing ground–water levels, springs, and depth to ground water, basin and range province, Nevada." U.S. Geological Survey, WRI 83–4119–B.

Bedinger, M.S., Sargent, K.A., and Langer, W.H., 1989, "Studies of the geology and hydrology in the Basin and Range Province, southwestern United States, for isolation of high–level radioactive waste—characterization of the Death Valley region, Nevada and California." U.S. Geological Survey Professional Paper 1370–F, pp 35.

Blankennagel, R.K., and Weir, J.E., 1973, "Geohydrology of the eastern part of Pahute Mesa, Nevada Test Site, Nye County, Nevada." U.S. Geological Survey Professional Paper 712–B, pp 35.

Burbe T.J. and Prudic, D.E., 1991, "Conceptual evaluation of regional ground–water flow in the carbonate–rock province of the Great Basin, Nevada, Utah, and adjacent states." U.S. Geological Survey, open–file report 90–560, pp 89.

Claassen, H.C. 1975, "Sources and mechanisms of recharge for groundwater in west–central Amargosa Desert, Nevada — a geochemical interpretation." U.S. Geological Survey Professional Paper 712–F, pp 31.

Dettinger, M.D., 1989, "Distribution of carbonate–rock aquifers in southern Nevada and the potential for their development, Summary of findings, 1985–88." Summary report 1, U.S. Geological Survey and Desert Research Institute, pp 37.

Dudley, W.W., Jr. and Larson, J.D., 1976, "Effect of irrigation pumping on Desert Pupfish habitats in Ash Meadows, Nye County, Nevada." U.S. Geological Survey Professional Paper 927, pp 52.

Kilroy, K.C., 1991, "Ground–water conditions in Amargosa Desert, Nevada–California, 1952–87." U.S. Geological Survey Water–Resources Investigations Report 89–4101, pp 93.

Harrill, J.R., Gates, J.S., and Thomas, J.M., 1988, "Major Ground–water Flow Systems in the Great Basin Region on Nevada, Utah, and Adjacent States." U.S. Geological Survey, Hydrologic Investigations Atlas, 694–C.

Harrill, J.R., 1992, U.S. Geological Survey, Carson City, Nevada; Personal Communication; October 6, 1992.

Malmberg, G.T and Eakin, T.E., 1962, "Ground–water appraisal of Sarcobatus Flat and Oasis Valley, Nye and Esmeralda Counties, Nevada." State of Nevada, Department of Conservation and Natural Resources; Ground–water resources – reconnaissance series, report 10, pp 39.

Mifflin, M.D., 1968, "Delineation of groundwater flow systems in Nevada." Desert Research Institute, Water Resources Center, Technical Report Series H–W, No. 4, pp 111.

Mifflin, M.D., 1968, "Delineation of groundwater flow systems in Nevada." Desert Research Institute, Water Resources Center, Technical Report Series H–W, No. 4, pp 111.

Miller, G.A., 1977, "Appraisal of the Water Resources of Death Valley, California–Nevada." U.S. Geological Survey, Open–file Report, 77–728, 68 pg.

Nevada State Engineer, 1991, unpublished data, on–file at Nevada State Engineer's office, Carson City, Nevada.

Nichols, W.D., 1987, "Geohydrology of the unsaturated zone at the burial site for low–level radioactive waste near, Beatty, Nevada, Nye County, Nevada." U.S. Geological Survey Water–supply Paper 2312, pp 52.

Special Nevada Report, 1991, Department of Energy, DE–AC08–88NV10715.

Waddell, R.K., Robinson, J.H., and Blankennagel, R.K., 1984, "Hydrology of Yucca Mountain and vicinity, Nevada–California investigation results through mid–1983." U.S. Geological Survey Water Resources Investigation 84–4267, pp 72.

Walker, G.E. and Eakin, T.E., 1963, "Geology and ground water of Amargosa Desert, Nevada–California." State of Nevada, Department of Conservation and Natural Resources; Ground–water resources – reconnaissance series, report 14, pp 45.

Winograd, I.J., and Thordarson, William, 1975, "Hydrogeologic and hydrochemical framework, south–central Great Basin with special reference to the Nevada Test Site." U.S. Geological Survey Professional Paper 712–C, pp 126.